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Carbon storage potential of a managed mountain grassland – Inverse modelling and uncertainty analysis

T. Liener (1), A. Hammerle (2), M. Williams (3), B. Scharnagl (4), M. Themeßl (5), A. Gobiet (5), and G. Wohlfahrt (2)

(1) Institute of Computer Science, University of Innsbruck, Innsbruck, Austria, (2) Institute of Ecology, University of Innsbruck, Innsbruck, Austria, (3) Institute of Atmospheric and Environmental Sciences, University of Edinburgh, Edinburgh, UK, (4) Institute of Bio- and Geosciences, Forschungszentrum Jülich, Jülich, Germany, (5) Wegener Zentrum für Klima und Globalen Wandel, Karl-Franzens-Universität Graz, Graz, Austria

Biogeochemical models are often difficult to calibrate due to their complex structure and/or their large number of parameters. To provide reliable results as well as defensible estimations of uncertainty any data-fusion approach has to account for and quantify all errors consisting of input, model structural and parameter errors.
Here we present a study of the carbon cycling of a managed temperate mountain grassland in the Austrian Alps. A ten year data set of measured carbon dioxide fluxes and aboveground biomass are combined with the grassland-adapted DALEC model and a big-leaf photosynthesis model. Parameter estimation of these models is done using a Bayesian inversion scheme. A vital part of this study is the correct residual handling and representation in the inverse parameter estimation scheme in order to provide a robust parameter- and predictive uncertainty estimation. This is achieved by using a generalized likelihood function that, in contrast to the formal approach, does not rely on independent and identically distributed errors according to a normal distribution, with zero mean and constant variance, which does not hold in many ecological applications.
After successful calibration these models are used to explore the carbon storage potential of the managed grassland ecosystem under different future management and climate scenarios. To evaluate interactive effects of future climate conditions and management strategies different likely climate scenarios are calculated and prescribed and management strategies (cutting dates and frequency) are optimized in regard to carbon storage and/or yield.